The Effects of Microalloying Elements on Cracking During Continuous Casting

D. N. Crowther

Corus Group, Swinden Technology Centre, Moorgate, Rotherham, S60 3AQ, UK

SUMMARY

To ensure the appropriate quality in finished products, it is important that defects in continuously cast products are minimised. As the use of hot charging and thin slab rolling coupled with direct rolling becomes more common, it is increasingly important to produce defect free continuously cast product, as inspection and repair in these situations becomes more difficult.

Of the many types of defect in continuously cast products, only transverse surface cracking is strongly influenced by the presence of microalloying elements. Nb has a particularly strong detrimental effect, and Nb additions of as low as 0.01% can promote cracking. For V steels with <0.005%N, transverse cracking does not appear to occur, although at high levels of V and N (0.15%V, 0.02%N), transverse cracking has been reported.

It is believed that transverse cracks form in the mould, and propagate later in the continuous casting process, particularly during the straightening process. Microalloyed steels can exhibit low ductility over certain temperature ranges, and when the straightening process is carried out in this low ductility region, cracking can occur. In this respect, Nb has a strong effect in deepening the ductility trough, and extending it to higher temperatures. This behaviour is due to the presence of Nb(CN) precipitates, which promote low ductility failures, and retard recrystallisation. The effect of V on hot ductility is much less marked, and only at high levels of V and N does their ductility approach that found in Nb steels. V additions to Nb steels appear to slightly improve hot ductility, by promoting coarser precipitates. The effects of Ti on hot ductility are complex and still not completely understood.

Transverse cracking may be minimised by appropriate selection of steel composition, such as minimising Nb, replacing Nb by V and N combinations, or by making V additions to Nb steels. Machine operating conditions such as secondary cooling strategy are also important in avoiding transverse cracking. By selecting straightening temperatures, which are outside the temperature range of low hot ductility, cracking can be reduced.

1. INTRODUCTION

During the production of continuously cast products, it is very important to avoid both surface and internal defects, as otherwise expensive and time consuming slab or bloom/billet repair operations are required, or defective final product may be produced. The production of defect free continuously cast products is becoming ever more important as the use of hot charging and direct rolling from thin slab casters increases. In these situations, inspection and repair of defects in continuously cast slab becomes more difficult, and the production of defect free continuously cast products is of vital importance.